

by the sinking waters of an inland lake or sea, may often be distinguished from those that have been formed and preserved under water. The former are usually imperfect through loss of their sharp ridges.* Occasionally in addition to this they form natural channels for surface drainage, and whilst their ridges are levelled, their furrows are deepened. This fact seems to be referred to by Dr. Geikie, in the third edition of his "Manual of Geology," where he points out, that owing to the ridges of fossil ripplemarks being often broad and equable while the intermediate furrow has a little channel; a cast can be distinguished from an original rippled surface, by the channel in the original surface producing a sharp little crest on the cast ("Man. Geol.," Jukes and Geikie, p. 172, 3rd Ed.).

The points that I have endeavoured to establish in the foregoing pages may be briefly recapitulated as follows:—Marine ripplemarks are formed by alternate currents set up by waves. Experiments with short high waves on a small scale prove strong action at a depth of half the wave-length, whilst the evidence of the marine fauna, and the testimony of nautical men go far to prove that ocean and channel waves strongly affect the sea bottom to at least the same relative depth. The depth at which proof of wave action can be forthcoming falls far short of that at which fine deposits can be rippled by currents incapable of leaving permanent traces in the damage done to shells.

It is scarcely necessary to point out that the subject treated of in the present paper, namely, the formation of ripplemark, is only one branch of a far wider and more important one, which for the sake of brevity, I have as much as possible kept in the back ground, namely, that of submarine denudation.

II. "Note on General Duane's Soundless Zones." By Dr. JOHN TYNDALL, F.R.S. Received March 21, 1882.

In reference to one of the powerful fog-whistles established on the coast of Maine, General Duane remarks as follows:—"The most perplexing difficulties, however, arise from the fact that the signal often appears to be surrounded by a belt varying in radius from 1 to $1\frac{1}{2}$ mile from which the sound appears to be entirely absent. Thus, in moving directly from a station the sound is audible for the distance of a mile, is then lost for about the same distance, after which it is again distinctly heard for a long time. This action is common to all ear-

* For an illustration of the former class see plate facing page 170 of "The World's Foundations," by Miss Agnes Giberne; and, for an illustration of the latter, see page 19 of Sir Charles Lyell's "Elements of Geology," 6th Edition. A.R.H., 4th May, 1882.

signals, and has been at times observed at all the stations, at one of which the signal is situated on a bare rock 20 miles from the main land, with no surrounding objects to affect the sound."

For a long time past, I have thought that this disappearance of the sound was due to the interference with the direct waves, of waves reflected from the surface of the sea. This explanation is capable of very accurate experimental illustration. Placing, for instance, a sensitive flame at a distance of 3 or 4 feet from a sounding reed, the flame exhibits the usual agitation. Lifting a light plank between the flame and reed, a position is easily attained where the sound, reflected from the plank, increases the flame's agitation. Lifting the plank cautiously still higher, a level is attained, reflection from which completely stills the flame. By slightly raising or lowering the plank, or by its entire removal, the flame is once more agitated. In these experiments a high pitched reed was used, so that it was easy to produce by the motion of the plank the retardation of half a wave-length requisite for interference.

In General Duane's case, a fairly smooth sea would be required for the reflection; while the position of the zone of silence would be determined by the height of the signal on the one hand and the height of the observer on the other above the surface of the sea. The position would also, of course, depend on the pitch of the note of the whistle.

The preparation of some lectures on the "Resemblances of Sound, Light, and Heat," has recently brought this subject to mind, hence the present communication.